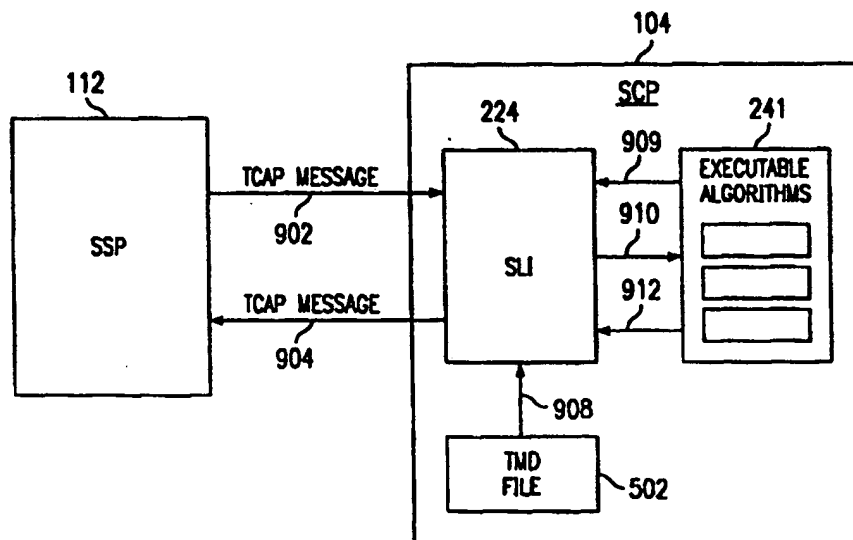




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(54) Title: SYSTEM AND METHOD FOR IMPLEMENTING PROGRAMMABLE TRANSACTION CAPABILITIES APPLICATION PART COMMUNICATION PROTOCOL



(57) Abstract

A method of implementing a transaction capabilities application part application protocol for transaction capabilities application part communication includes providing a transaction capabilities application part message definition. The method also includes generating a plurality of service independent building blocks to form a service logic program associated with transaction capabilities application part communication. At least one of the plurality of service independent building blocks associates a plurality of leaf-node parameters with respective variables in the at least one service independent building block. The leaf-node parameters are specified by fully qualified names derived from the transaction capabilities application part message definition. The method also includes creating an executable form of the service independent building blocks for execution.

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SYSTEM AND METHOD FOR IMPLEMENTING
PROGRAMMABLE TRANSACTION CAPABILITIES
APPLICATION PART COMMUNICATION PROTOCOL

TECHNICAL FIELD OF THE INVENTION

This invention is related in general to the field of telecommunications systems. More particularly, the invention is related to a system and method for
5 implementing a programmable transaction capabilities application part application protocol.

BACKGROUND OF THE INVENTION

The public telecommunications network makes extensive
10 use of signaling system number 7 (SS7) protocol to communicate among the various network elements. End to end routing of a signaling system number 7 message often requires the use of the transaction capabilities application part (TCAP) portion of the signaling system
15 number 7 protocol. The transaction capabilities application part enables the deployment of advanced intelligent network services by supporting non-circuit related information exchange between signaling points. For example, a service switching point (SSP) uses the
20 transaction capabilities application part to query a service control point (SCP) to determine the routing number associated with a dialed 800, 888, or 900 number. The service control point uses the transaction capabilities application part to return back to the service switching
25 point a response containing the routing number. Calling

card calls are also validated using transaction capabilities application part query and response messages. Furthermore, when a mobile subscriber roams into a new mobile switching center area, an integrated visitor location register may request service profile information from a subscriber's home location register using information carried within transaction capabilities application part messages.

Communication of transaction capabilities application part messages between two or more nodes in an intelligent network conventionally takes place using an application protocol defined by standard committees such as Bellcore or ETSI. Two such application protocols are INAP, defined by ETSI and AIN 0.1, defined by Bellcore. Each application protocol has a message set that defines how information is communicated between intelligent network nodes. The message set for an application protocol is specified by a standards committee in such a way as to give the service provider some message content flexibility. Therefore, for some message fields, the service provider may define the content of the message fields. Because each application protocol developed for each customer uses some message information that is customer specific, message information for an application protocol is typically defined in the source code of the programs using the application protocol.

Because customer specific message information is contained in the source code of programs using an application protocol, it is possible that several versions of an application protocol used for transaction capabilities application part messages must be maintained. Creating and maintaining multiple source code versions of the same application protocol adds complexity and requires additional development resources. Furthermore, modifications to any particular customer's application

protocol are cumbersome because they require changes to the source code of the programs using the application protocol. In today's fast-paced telecommunications environment, this tedious and time-consuming service implementation method is unacceptable.

SUMMARY OF THE INVENTION

Accordingly, a need has arisen for the implementation of a transaction capabilities application part protocol in a quick and easy manner without the delay and effort associated with traditional software development processes. Thus the teachings of the present invention provide a system and method for implementing programmable transaction capabilities application part communication protocol.

According to one embodiment of the invention, a method of implementing a transaction capabilities application part application protocol for transaction capabilities application part communication includes providing a transaction capabilities application part message definition. The method also includes generating a plurality of service independent building blocks to form a service logic program associated with transaction capabilities application part communication. At least one of the plurality of service independent building blocks associates a plurality of leaf-node parameters with respective variables in the service independent building block. The leaf-node parameters specified by a fully qualified names are derived from the transaction capabilities application part message definition. The method also includes creating an executable form of the service independent building blocks for execution.

According to another embodiment of the invention, a system for implementing a transaction capabilities application part application protocol for transaction

capabilities application part communication includes a transaction capabilities application part message set definition having a plurality of messages and parameters specifying the transaction capabilities application part application protocol. The system also includes a plurality of service independent building blocks having internal variables. The plurality of service independent blocks associate the internal variables with fully qualified names that specify leaf-node parameters that are derived from the transaction capabilities application part message definition set. A graphical editor is included that is adapted for facilitating a user to select and link the plurality of service independent building blocks to form a logic program associated with a transaction capabilities application part messages. The system also includes an object library having a plurality of pre-defined object classes each corresponding to a service independent building block. The system also includes a logic interpreter adapted for receiving the logic program and creating instances of objects from the pre-defined object classes in the object library to correspond with the plurality of service independent building blocks in the logic program to produce an executable logic program operable to receive transaction capabilities application part information identified by fully qualified names specifying leaf-node parameters and transmit transaction capabilities application part information associated with fully qualified names specifying leaf-node parameters.

The invention provides several technical advantages. For example, an application protocol is provided that does not require recoding the program that executes tasks associated with transaction capabilities application part messages. This reduces complexity and the need for additional development resources. Furthermore, because the

definition of an application protocol is not done at compilation time, users such as a service creation environment (SCE) or a service control point (SCP) are no longer required to put protocol specific information in the source code of programs developed by those users. Moreover, service independent building blocks no longer rely on source code specification of parameters. Thus no service independent building block source code changes are required to change message parameters or a protocol definition. In addition, because service independent building blocks use parameter definitions provided according to teachings of the invention, service designers have access to all parameters defined for a message in the application protocol when designing services using a service creation environment.

Furthermore, according to the invention, access is provided to all of an application protocol's messages through the use of just four service independent building blocks. Thus adding messages or parameters to an application protocol does not require any service creation environment or service independent building block code changes.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference may be made to the accompanying drawings, in which:

FIGURE 1 is a block diagram of an exemplary telecommunications network such as an advanced intelligent network (AIN);

FIGURE 2A is a simplified block diagram illustrating the use of service independent building blocks (SIBs);

FIGURE 2B is a simplified flow chart of an embodiment of a logic interpretation process;

FIGURE 3 is a block diagram of a signaling system number 7 (SS7) message structure used in the telecommunications network illustrated in FIGURE 1;

5 FIGURE 4 is a simplified block diagram illustrating one example of a transaction capabilities application parts message;

10 FIGURE 5 is a simplified block diagram showing the creation of services associated with transaction capabilities application part messages using an application protocol defined according to the teachings of the invention;

FIGURE 6 is exemplary details of the transaction capabilities application part message definition file illustrated in FIGURE 4;

15 FIGURE 7 is exemplary details of the service independent building block template file illustrated in FIGURE 4;

FIGURE 8 is exemplary details of a portion of a service logic program; and

20 FIGURE 9 is a block diagram illustrating the handling of a service associated with a transaction capabilities application part message.

25 DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present invention are illustrated in FIGURES 1 through 10, like reference numerals being used to refer to like and corresponding parts of the various drawings.

30 FIGURE 1 is a block diagram of a telecommunications network 100 such as an advanced intelligent network (AIN). Network 100 includes a service management system 102 that interfaces with a plurality of service control points (SCP) 104 and a plurality of signal transfer points (STP) 106 via

an industry standard protocol, such as X.25. Service management system 102 provides network information, database management, and administrative support for network 100. Service management system 102 generally interfaces with service control points 104 for provisioning, database management, service control point application program management, and collecting traffic metering and measurement data. Service control points 104 are also directly linked to signal transfer points 106 via a signaling system number 7 (SS7) linkset 108. Signal transfer points 106 are further coupled through signaling system number 7 linkset 108 to one or more service switching points 112 and 114, which perform switching and call-handling functions in the network. Service control points 104 are transaction-based processing systems whose primary responsibility is to respond to queries from service switching points 112 and 114 for data needed to complete routing a call. Service switching points 112 and 114 are part of the public switched telephone network (PSTN) 120 and are coupled to the telephone service subscribers or customers 122, which includes wire-based telephones, wireless telephones, and intelligent peripherals 122.

The creation and delivery of service logic programs (SLPs) is the function of a service creation environment (SCE) 126, which is coupled to service management system 102. Service creation environment 126 allows users and programmers to create service logic programs that define the desired advance intelligent network service processing. These programs may then be downloaded to service control points 104 and signal transfer points 106 through service management system 102 for execution. Service logic programs define the triggering events encountered in service switching points 112 and 114 that require database access and logic for additional processing of telephone

calls. Users and programmers of service creation environment 126 may interface with service creation environment 126 through a computer terminal 130 coupled to service creation environment 126.

5 Service independent building blocks (SIBs) are building blocks that have been developed to construct service logic programs to implement network services. The service independent building blocks, as defined in the International Telecommunications Union CCITT ITU-T Q.1213,
10 are used in the service creation environment to produce service logic programs that are then downloaded to service management system 102, service control point 104, and/or signal transfer points 106, where they are executed.

FIGURE 2A is a simplified block diagram illustrating
15 the use of service independent building blocks (SIBs). Several different classes or types of service independent building blocks 200 are illustrated in FIGURE 2, including Entry 202, Action 204, Decision 206, System 208, and Input
20 210. Three types of action service independent building blocks 204 are Set 211, Get 213, and SendReceive 215. These different classes of service independent building blocks, which are collectively illustrated through icons
25 203, can be linked to form a service logic program 220. In a preferred embodiment, a graphical editor may be used to facilitate the creation of service logic programs 220. An
30 example graphical editor 505 is illustrated in FIGURE 5. Icons 203 of service independent building block classes may then be picked up and dropped into a workplace and are linked together to form a service logic program such as service logic program 220. An ASCII text file is then created from the linked service independent building block, which is converted to an executable algorithm 241 by a logic interpreter 224. As discussed in greater detail below, an object library 240 may be used to facilitate

generation of executable algorithms 241. When executable algorithm 241 is executed, instances of each class of service independent building blocks are created, which have the same behaviors and functionality defined by the class.

5 In this manner, the same code for the same service independent building blocks may be reused in many logic programs without duplicating the effort to recode the logic.

FIGURE 2B is a simplified flowchart of an embodiment of the logic interpretation process 230. Logic interpreter 224 or process 230 therefore may include two components: a parser 232 and an execution function 234. Parser 232 first reads service logic program 220 and validates, as shown in step 236. Thereafter, parser 232 creates an

10 instance of a C++ object for each service independent building block by accessing previously generated C++ object classes for templates stored in a C++ object library 240, as shown in step 238. These instances are linked to form an executable algorithm 241.

20 During run time, execution function 234 receives queries or requests, and selects the appropriate C++ logic program to perform the necessary functions requested. The selected logic programs in C++ are then executed to handle transaction capabilities application part services. The

25 process flow terminates in step 248. In this manner, the same C++ code for the same service independent building block may be reused in many transaction capabilities application part logic programs without duplicating the effort to recode the logic.

30 FIGURE 3 is a block diagram of a signaling system number 7 (SS7) message structure 300. As illustrated, signaling system number 7 message structure 300 has a message transfer part (MTP) 302, user parts 304, a signaling connection control part (SCCP) 306, and a

transaction capabilities application part (TCAP) 308. The message transfer part 302 contains necessary mechanisms to insure reliable transmission of functional signaling messages. The signaling connection control part 306 provides the means to control logical signaling connections in the network and transfer signaling data units across a network. Signaling connection control part 306 also provides a routing and translation function that allows signaling messages to be routed to a signaling point. Transaction capabilities application part 308 provides the means to exchange operations and replies via a dialogue. Transaction capabilities application part 308 provides the means to establish non-circuit related communication between two nodes in the signaling network.

As illustrated, transaction capabilities application part 308 contains a component portion 310 and a transaction portion 312. Transaction portion 312 contains a package type identifier. Package types include: unidirectional query with permission, query without permission, response, conversation with permission, conversation without permission, and abort.

A unidirectional package type transfers components in one direction only. A query without permission package type initiates a transaction capabilities application part 308 transaction, such as a 1-800 query. In a query with permission package type, the destination node may end the transaction. A query without permission package type initiates transaction capabilities application part 308 transaction in which a destination node may not end the transaction. A response package type ends transaction capability application part 308 transaction. For example, a response to a 1-800 query with permission may contain the routing number associated with the 800 number. A conversation with permission package type continues a

transaction capabilities application part transaction. In a conversation without permission package type, the destination node may end the transaction. A conversation without permission package type continues a transaction capabilities application part transaction. In such a case, the destination node may not end the transaction. An abort package type terminates a transaction due to an abnormal situation. In addition to containing package type identifiers, transaction portion 312 also contains an originating transaction identification and a responding transaction identification field, which associate the transaction capabilities application part 308 transaction with a specific application at the originating and destination signaling points respectively.

Component portion 310 of transaction capabilities application part 308 contains components. Types of components include invoke (last), invoke (not last), return result (last), return result (not last), return error, and reject. Components include numbers representing parameters associated with a transaction capabilities application part message. Because such parameters may be customer-specific, conventionally, each time a customer would request additional capabilities, the protocol for receiving transaction capabilities application part messages had to be modified each time a service was added. The present invention addresses this disadvantage by providing a system and method for adding or modifying the services available to a customer without modifying the application protocol associated with these services.

The invoke (last) component invokes an operation. For example, a query with permission transaction may include an invoke (last) component to request a service control point translation of a dialed number. The invoke (not last) component is similar to the invoke (last) component except

that it is followed by one or more components. The return result (last) returns the results of an invoked operation, and the return result (not last) returns the results of an invoked operation but followed by one or more components.

5 The return error component reports an unsuccessful completion of an invoked operation, and the reject component indicates that an incorrect package type or component was received.

FIGURE 4 is a simplified block diagram illustrating an example of a transaction capabilities application parts message transmitted between service switching point 112 and service control point 104. As described above, transaction capabilities application part 308 enables the deployment of advanced intelligent network services by supporting non-circuit related information exchange between signaling points. In the example illustrated in FIGURE 4, a telephone call is placed using telephone 122 to a 1-800 number 402. In response to receiving dialed 1-800 number 402, service switching point 112 transmits a transaction capabilities application part query message 404 to query service control point 104 to determine the routing number associated with dialed 1-800 number 402. Service control point 104 returns back to service switching point 112 a transaction capabilities application part, response message 406, 408 containing the routing number. Query message 404 and response message 406, 408 are examples of transaction capabilities application part 308 messages. As illustrated, the routing number returned may vary depending upon the time of day or the location from which the dialed 1-800 number 402 was received. Once the service switching point receives response 406, 408 containing a routing number, service switching point 112 may route dialed 1-800 number 402 to the correct location based on response 406, 408. Thus, transaction capabilities application part 308

messages enable the deployment of advanced intelligent network services by supporting non-circuit related information exchange.

5 Another example of an advanced intelligent network service provided through a transaction capabilities application part 308 message is roaming. As a mobile telephone moves between new roaming areas, a local visitor location register requests service profile information from the mobile telephone user's home location register. This
10 request is performed using information carried within a transaction capabilities application part 308 message.

The transaction capabilities application part 308 messages associated with services such as 1-800 routing and roaming are transmitted between service switching point 112 and service control point 104 according to an application
15 protocol defined for a given customer. Conventionally, such an application protocol specifies the format for transmitting and receiving a transaction capabilities application part 308 message, such as query message 404 or
20 response message 406, 408. This specification is conventionally performed by a trigger integer, which specifies a type of message, and a series of integers following the trigger integer in a particular order that corresponds to various parameters associated with the
25 message. If additional services are desired by a given customer, however, difficulties arise. For example, the application protocol for a given customer must be modified to include a protocol for the new service. In addition, the application programs executing the given service must
30 be modified to correspond to that new protocol. If a service is modified to include, for example additional parameters associated with an existing service, both the application protocol and the associated service logic programs have to be modified to reflect changes in the

application protocol resulting from changes in the service. Conventionally, such modifications require computer code changes that are time consuming. In addition, conventionally service logic interpreter 224 must be
5 modified to be able to parse and execute the modified service logic programs 220. According to the invention, services using transaction capabilities application part 308 messages may be easily added or modified for a given customer without the need for modifying the code associated
10 with the service and without modifying service logic interpreter 224.

FIGURE 5 illustrates a simplified block diagram showing the creation of executable algorithms associated with transaction capabilities application part 308 messages according to the teachings of the invention. FIGURES 6
15 through 8 illustrate exemplary details of various components of the block diagram illustrated in FIGURE 5. The illustrated steps may be performed within service creation environment 126 to create service independent building blocks, such as service independent building
20 blocks 203, that may be linked together to form a service logic program, such as service logic program 220. Service logic program 220 may then be used by a service logic interpreter, such as service logic interpreter 224, to
25 generate executable algorithms, such as executable algorithms 241, which are used by service control points 104 and/or service switching points 112 to communicate transaction capabilities application part messages.

As illustrated in FIGURE 5, service creation
30 environment 126 includes a transaction capabilities application part message definition file (TMD File) 502. As described in greater detail below, transaction capabilities application part message definition file 502 contains all transaction capabilities application part

messages available to a given customer. Transaction capabilities application part message definition file 502 also defines the parameters associated with each message. In addition, transaction capabilities application part message definition file 502 also associates a tag integer with a respective message. A tag integer associated with a given transaction capabilities application part message definition file 502 may be received by service control point 104 rather than the actual name of the desired message.

Service creation environment 126 also may include a utility 508 that creates, based on transaction capabilities application part message definition file 502, a service independent building block template file 504. As described in greater detail below, service independent building block template file 504 associates particular parameters defined in transaction capabilities application part message definition file 502 with variable names that are used by a designer in constructing a service logic program, such as service logic program 220.

Service creation environment 126 also may include a service logic program graphical editor 505 for facilitating generation of a service logic program 506. By utilizing service logic program graphical editor 505, a service designer may link together a plurality of service independent building blocks that incorporate the contents of service independent building block template file 504 to form service logic program 506. As described above, service independent building block template file 504 associates particular parameters associated with the messages contained in transaction capabilities application part message definition file 502 with service logic program variables names used during the creation of service logic

program 506 and during execution of service logic program 506.

Prior to the teachings of the present invention, a service designer utilizing a service creation environment for service creation used dedicated service independent building blocks, one for each message type, that had parameter information imbedded in the source code of the dedicated service independent building blocks. Adding messages to accommodate new services or additional parameters to existing messages required changing the source code of the service independent building blocks. The source code of the service independent building block conventionally included information specifying the parameters that were associated with particular messages and the structure of the associated parameters. Therefore, adding or modifying services, which conventionally resulted in a modification of the application protocol associated with transaction capabilities application part 308 messages, conventionally required rewriting the source code of the service independent building blocks to reflect the change in protocol. In addition, each time a new service independent building block was added, service logic interpreter 224 required modification to be able to execute the newly-added or newly-modified service independent building block.

By contrast, according to an embodiment of the invention and as described in greater detail below, service creation environment 126 provides access to all of an application protocol's messages and parameters through the use of four service independent building blocks, including access to subsequently-developed messages and parameters. These service independent building blocks are Entry 202, Set 211, Get 213, and SendReceive 215, illustrated in FIGURE 2A. Adding messages or parameters to an application

protocol does not require any service creation environment or service independent building block code changes.

5 An embodiment of the invention provides an application protocol that uses a fully qualified name and a parameter structure to specify a parameter. According to one embodiment of the present invention, a fully qualified name is an ASCII text string of period-delimited parameter names that specifies a parameter that cannot be further subdivided to other parameters. Such a parameter is referred to as a leaf-node parameter. For example, as 10 illustrated in the last line of FIGURE 7, the term "calledPartyID.digits" is a parameter that specifies the digits associated with the phone number of a calling party. Other leaf-node parameters or fully qualified names illustrated in FIGURE 7 include "calledPartyID.odd_even", 15 "calledPartyID.nat_of_num", "calledPartyID.spare", "calledPartyID.num_plan", "calledPartyID.pri", and "CalledPartyID.si." By contrast, conventionally, a parameter such as "callingPartyID" would be specified by an integer string with specified portions of the string 20 corresponding to each of the above-listed parameters.

FIGURE 6 illustrates exemplary details of a portion of transaction capabilities application part message definition file 502. A more complete listing of an example 25 transaction capabilities application part message definition file 502 is provided in Table 1. Transaction capabilities application part message definition file 502 is an ASCII file that is used to specify a transaction capabilities application part application protocol, which may be written, for example, in Tcl syntax. Tcl is a high- 30 level scripting language known in the industry. Each transaction capabilities application part message definition file 502 contains the definition of a single transaction capabilities application part application

protocol. Examples of Tcl commands related to the present invention that are used to describe an application protocol are: PROTOCOL, OCTSTR, and SEQUENCE. PROTOCOL defines messages supported by the protocol; OCTSTR defines ASN.1
5 octet-string-type parameters; and SEQUENCE defines ASN.1 sequence-type parameters. The parameter reference structure defined in transaction capabilities application part message definition file 502 contains information relating to a message and its specified parameters. Based
10 on the parameter reference structure contained in transaction capabilities application message definition file 502, upon execution of an executable algorithm such as executable algorithms 241, a service logic interpreter can access parameter values for use in processing transaction
15 capabilities application part 308 messages.

As illustrated in FIGURE 6, the term "SEQUENCE" specifies a data type for a transaction capabilities application part 308 message "InfoAnalyzed." The term "calledPartyID" is a parameter and the phrase
20 "CalledPartyID OPT" specifies an optional data type for calledPartyID. The integer "15" is a tag associated with the parameter calledPartyID. A transaction capabilities application part message received at, for example, service control point 104, may include such a tag rather than the
25 name of the desired message. Upon reception of a transaction capabilities application part message 508, service control point 104, transaction capabilities application part message definition file 502 is accessed to associate the received tag with its associated message and
30 parameters specified in transaction capabilities application part message definition file 502. The phrase "USER_DEFINE CalledPartyID AINDigits" initiates definition of the user-defined data type "CalledPartyID."

The phrase "BITFIELD AINDigits defines seven leaf-node parameters associated with parameter called the party ID.

To change parameters for a given service or to add additional messages, transaction capabilities application part message definition (TMD) file 502 is modified. A
5 starting point for creating transaction capabilities application part message definition file 502 may be a document that defines a standard application protocol using ASN.1 grammar. An example of such a document is a standard
10 specified by Bellcore. A customer may then supply a customer-specific definition of parameters that may be used to supplement the standard committee document to create the TMD file.

As illustrated in FIGURE 5, a service independent building block template file 504 may be derived from
15 transaction capabilities application part message definition file 502. One way of generating a service independent building block template file 504 is through the use of a utility 508, which generates service independent
20 building block template file 504 from transaction capabilities application part message definition file 502. As described above, service independent building block template file 504 associates the fully qualified names of "leaf-node" parameters of the application protocol
25 specified within the transaction capabilities application part message definition file 502 with corresponding service logic program variable names that may be used by a service designer in service creation environment 126 to create a service logic program such as service logic program 220.

30

FIGURE 7 illustrates example portions of service independent building block template file 504, which shows examples of fully qualified names identifying leaf-node parameters and their corresponding service independent

building block variable. For example, the last line of information in FIGURE 7 reads "EXTDEF_PARAM:Var: phone_nr_type_id calledPartyID.digits CalledPID_digits alloc_call Edt:001." This command associates the fully qualified name "CalledPartyID.digits" with the variable name "CalledPIP_digits" that may be used by a service designer in creating service logic program 506. Associating a fully qualified name of a leaf-node parameter with a variable name that may be used by service designer in creating a service logic program, such as service logic program 506, enables a service designer to utilize variable names with which he is familiar and also allows the use of short, easy-to-remember variable names. As an intermediate step in generating service independent building block template 504, a "dot" file listing all fully qualified names that may be generated from transaction capabilities message definition file 502 may be generated. An example of such a file is provided in Table 2.

Service independent building block template file 504 may be used by service logic program graphical editor 505 for creating service logic programs, such as service logic program 506, which is analogous to service logic program 220. Service logic program 506 incorporates the application protocol defined in the transaction capabilities application part message definition file 502 by associating the leaf-node parameters obtained from transaction capabilities application part message definition file 502 with service logic program variable names.

To generate service logic program 506, a service designer may link multiple service independent building blocks, such as service independent building blocks 203, to form service logic program 506. As described above, four service independent building blocks are particularly

important to generating service logic programs used for transaction capabilities application part messages. These four service independent building blocks are Entry 202, Set 211, Get 213 and SendReceive 215. Service independent building block Get 213 retrieves the value of each parameter associated with a received message. Service independent building block Set 211 assigns values to parameters associated with a chosen message. Service independent building block Entry 202 is the entry point to a service independent building block upon receipt of a transaction capabilities application part message. Service independent building block SendReceive 215 is used to send and receive TCAP messages.

As an example, a service designer may use the service independent building block Get 213 to retrieve a value associated with a parameter associated with an InfoAnalyzed message. To do so, during creation of a service logic program for use with an InfoAnalyzed message, the service logic designer may select the message InfoAnalyzed from a menu provided by service independent building block Get 213 that lists all possible messages available with a given transaction capabilities part protocol specified by transaction capability application part message definition file 502. Selecting a message incorporates the parameters associated with that message into the service independent building block Get 213 for use in a resulting service logic program. In such a manner, service logic programs may be easily created to include new messages contained within transaction capabilities application part message definition file 502 or new parameters associated with messages contained in transaction capabilities application part message definition file 502.

Once creation of service logic program 506 is completed, it can be executed by a service logic

interpreter 224 within, for example, service control point 104 (FIGURE 9) to process transaction capabilities application part 308 messages received from or sent to, for example, service switching points 112 and 114. Upon
5 execution of service logic program 506, service logic interpreter 224 creates service independent building block objects based on the content of the service logic program 506 being processed. Each service independent building block object, when constructed, incorporates the
10 application protocol specified by transaction capabilities application part message definition file 502.

FIGURE 8 illustrates and details of a portion of service logic program 506. FIGURE 8 shows commands associated with one service independent building block that
15 is included in a portion of service logic program 506. Service logic program 506 may include a plurality of service independent building blocks that may be linked together using service logic program graphical editor 505. A portion of service logic program illustrated in FIGURE 8
20 associates a fully qualified name for a leaf-node parameter based on service independent building block template file 504. The purpose of service logic program 506 is to define the parameters that may be associated with a given message, such as, for example, InfoAnalyzed, to define the types of
25 variables associates with the parameters, and to define the type of action associated with the specified message. For example, the first line of service logic program 506, which reads "SIB Code: ACTION 4", specifies that the class of the service independent building block is "action" and also
30 specifies the service independent building block identification number associated with the service independent building block. In this case, the service independent identification number is 4, which corresponds to this particular service independent building block being

the fourth service independent building block generated in the current service logic program. The second line of service logic program, which reads "SIB_Type: SIB__action_get action_get", specifies that the particular
5 type of action for this service independent building block is a get action. Except for the last line of information, the additional lines of information are associated with the leaf-node parameters associated with the message InfoAnalyzed. These lines of information specify the
10 variable type associated with a leaf-node parameter and also associate a leaf-node parameter with a variable name that may be used by a service designer in service creation environment 126 based upon the service independent building block template file 504. For example, the third line in
15 FIGURE 8 specifies that the leaf-node parameter, having a fully qualified name of "CalledPartyID.nat_of_num", has an integer type in that it is associated with the variable name "CalledPID_nat_of_num" that may be used by a service designer and service creation environment 126. The last
20 line of the service independent building block illustrated in FIGURE 8 specifies the message associated with the service independent building block. As illustrated in FIGURE 8, the service independent building block is associated with an InfoAnalyzed message.

25 Thus, according to one embodiment of the invention, service logic programs such as service logic program 506 may be created based on transaction capabilities application part message definition file 502 that incorporate the parameter reference structure specified by
30 transaction capabilities application part message definition file 502 and that associate a fully-qualified name for a leaf-node parameter with a service logic program variable. As described in greater detail below, this allows execution of executable algorithms 241 without

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rewriting the code for service logic interpreter 224 each time an additional message or a modified message is desired.

FIGURE 9 illustrates the execution of executable algorithms 241 by service logic interpreter 224 according to the teachings of the present invention. Executable algorithms 241 are the executable form of service logic program 506. Upon receiving a transaction capabilities application part message 902, service logic interpreter located in, for example, service control point 104 performs several functions. These functions include decoding, or translation, of transaction capabilities application part message 902, service selection, and service execution.

According to industry standards, transaction capabilities application part message 902 consists of an encoded bitstream specifying a message and its associated parameters. According to one embodiment of the invention, service logic interpreter 224 accesses transaction capabilities application part message definition file 502 to decode transaction capabilities application part message 902. Decoding allows service logic interpreter 224 to know what message was sent, and therefore, what parameters associated with the message to expect. Thus service logic interpreter 224 translates an encoded bitstream specifying a particular message and its associated parameters into a set of fully-qualified names that are understandable by service logic programs 506 and executable algorithms 241. This translation process is illustrated by reference numeral 908.

Once transaction capabilities application part message 902 is translated, service logic interpreter 224 selects an executable algorithm 241 and executes the service independent building blocks associated with the selected executable algorithm. In doing so, service logic

interpreter 224 provides the value of a leaf-node parameter to executable algorithm 241 in response to a request by executable algorithm 241 specifying a fully-qualified name for a desired leaf-node parameter. The request
5 incorporating the fully-qualified name is illustrated by reference numeral 909. The provision of a value corresponding to the request 909 is illustrated by reference numeral 910. Because service logic programs 506 were created according to the procedure described with
10 reference to FIGURES 5 through 8, executable algorithm 241 can receive and understand values of parameters specified by a fully qualified name. For example, execution of service independent building block Get 213 gets the value corresponding to a parameter identified by a fully
15 qualified name. Once the value of a parameter is obtained, internal variable names are used within executable algorithm 241. Thus, the fully-qualified name for a parameter allows communication of parameter values between service logic interpreter 224 and executable algorithm 241.
20 Once an executable algorithm 241 has completed its assigned task, a value may be assigned to another parameter associated with transaction capabilities application part message 902 through the service independent block Set 211. This is accomplished by transmitting a fully-qualified name
25 for the parameter and a value to be assigned to that parameter from the executable algorithm 241 to service logic interpreter 224. This transmission of a fully-qualified name and an associated value is illustrated by reference numeral 912. In addition, a response message may
30 be sent utilizing service independent block SendReceive 215.

Once service logic interpreter 224 receives a response from executable algorithm 241, it may translate the message into a bitstream of encoded data for transmission to

service switching point 112. This translation is performed in a manner analogous to the translation described above and is represented by reference numeral 908. Once translated, a transaction capabilities application part message response 904 may be transmitted to service switching point 112.

The below Table 1 illustrates one example of a transaction capabilities application part message definition file 502.

TABLE 1

```

#####
## Section 1. Protocol
#####
10 PROTOCOL CUSTOMERNAME 1.0 PRIVATE {
15   { 25857 AnalyzeRoute      {} { ApplicationError } }
     { 28161 Close           {} { ApplicationError } }
     { 25869 Continue {} { ApplicationError } }
     { 25859 Disconnect {} { ApplicationError } }
20   { 25603 InfoAnalyzed     {} { ApplicationError FailureReport }
     { AnalyzeRoute Continue SendToResource Disconnect } }
     { 28417 ReportError     {} { ApplicationError } }
     { 26113 SendToResource  {} { ApplicationError } }
   }

25 #####
## Section 2. Messages
#####
SEQUENCE AnalyzeRoute {
30   { chargeNumber          19 ChargeNumber OPT }
     { callingPartyID       18 CallingPartyID OPT }
     { calledPartyID        15 CalledPartyID OPT }
     { outputPulseNumber    37 OutputPulseNumber OPT }
     { primaryTrunkGroup    42 PrimaryTrunkGroup OPT }
     { alternateTrunkGroup  5 AlternateTrunkGroup OPT }
35   { secondAlternateTrunkGroup 48 SecondAlternateTrunkGroup OPT }
     { extensionParameter   84 ExtensionParameter OPT }
     { genericAddressList   107 GenericAddressList OPT }
   }

40 SEQUENCE Close {
   { userID          53 UserID OPT }
   { bearerCapability 13 BearerCapability OPT }
   { closeCause      72 CloseCause OPT }
}

45 ## { extensionParameter 84 ExtensionParameter OPT } deleted
    from Close msg

SEQUENCE Continue {
50   { extensionParameter 84 ExtensionParameter OPT }
}

SEQUENCE Disconnect {

```

```

    { extensionParameter      84 ExtensionParameter OPT }
}

SEQUENCE InfoAnalyzed {
5   { userID      53 UserID }
    { bearerCapability 13 BearerCapability }
    { calledPartyID   15 CalledPartyID OPT }
    { triggerCriteriaType 52 TriggerCriteriaType }
    { chargeNumber 19 ChargeNumber OPT }
10  { callingPartyID 18 CallingPartyID OPT }
    { carrier        41 Carrier OPT }
    { accessCode     1 AccessCode OPT }
    { collectedAddressInfo 22 CollectedAddressInfo OPT }
    { collectedDigits 23 CollectedDigits OPT }
15  { extensionParameter 84 ExtensionParameter OPT }
}

SEQUENCE ReportError {
    { applicationErrorString 55 ApplicationErrorString }
20 }
## { extensionParameter      84 ExtensionParameter OPT } deleted
   from ReportError

25 SEQUENCE SendToResource {
    { resourceType      45 ResourceType }
    { strParameterBlock 50 StrParameterBlock }
    { disconnectFlag    25 NULL OPT }
    { answerIndicator   12 NULL OPT }
30 }
## { extensionParameter      84 ExtensionParameter OPT } deleted
   from SendToResource

35 RE Ain02RE {
    { 1 ApplicationError }
    { 2 FailureReport }
}

40 #####
## Section 3. Parameters
#####

45 ## 3.1 Primitive Parameters
## 3.1.1 INTEGER
INTEGER ClassOfSvc      0 1023
INTEGER ResourceType    0 255
INTEGER ServTranslationScheme 1 999
50 --

## 3.1.2 BCDOCTSTRING
### numbers are no of digits
BCDOCTSTR Dn            10 10
55 BCDOCTSTR UniversalAccess 10 10

## 3.1.3 OBJECTID
## The given value is incorrect in the document;
## The correct value should be "1.2.840.113533.8.65.16".
60 OBJECTID AssignmentAuthority "1.2.836.97021.8.65.16"

```

28

3.1.4 OCTSTRING

numbers are no of bytes

OCTSTR BillSequenceNumber

4 4 # This has been moved to

BITFIELD

5 OCTSTR CallBranding 2 2

3.1.5 ENUMERATED

10 ENUM BearerCapability {

```

    { speech 0 }
    { f31kHzaudio 1 }
    { f7kHzaudio 2 }
    { b56kbps 3 }
    { b64kbps 4 }
    { multiRate 6 }

```

15

ENUM CallType {

```

    { onnet 0 }
    { offnet 1 }

```

20

ENUM CloseCause {

```

    { callTerminated 0 }
    { eDPsCompleted 1 }
    { unexpectedCommunication 2 }
    { calledPartyAnswered 3 }

```

25

30

ENUM ErrorCause {

```

    { erroneousDataValue 0 }
    { missingConditionalParameter 1 }
    { responseMessageTimerExpired 2 }
    { unexpectedCommunication 3 }
    { unexpectedMessage 4 }
    { unexpectedMessageSequence 5 }
    { unexpectedParameterSequence 6 }

```

35

40

ENUM FailureCause {

```

    { rateTooHigh 1 }
    { unavailableResources 2 }
    { apTimeout 3 }
    { apbusy 4 }
    { channelsBusy 13 }
    { abort 14 }
    { resourceLimitation 15 }
    { applicationError 16 }
    { securityError 17 }
    { protocolError 18 }
    { timerExpired 19 }
    { temporaryFailure 20 }
    { mwiUnderSmdiControl 21 }
    { segmentationError 22 }
    { ncasDisallowed 23 }
    { controlEncountered 24 }
    { improperCoding 25 }
    { inappropriateCondition 26 }
    { inappropriateUserInterface 27 }
    { inappropriateLegManipulation 28 }

```

45

50

55

60

29

```

ENUM TriggerCriteriaType {
    featureActivator          0 }
    verticalServiceCode      1 }
    customizedAccess         2 }
5    customizedIntercom     3 }
    npa                      4 }
    npaNXX                   5 }
    nxx                      6 }
    nxxxxxx                  7 }
10   npaNxxxxxx             8 }
    countryCodeNPANxxxxxxx  9 }
    carrierAccess           10 }
    prefixes                11 }
    n11                     12 }
15   aFR                    13 }
    sharedIOTrunk           14 }
    terminationAttempt      15 }
    offHookImmediate        16 }
    offHookDelay            17 }
20   channelSetupPRI        18 }
    npaN                    19 }
    npaNX                   20 }
    npANXXX                 21 }
    npANxxxx                22 }
25   npANxxxxx              23 }
    networkBusy             24 }
    sds_info                100 }
    sds_ani                 101 }
30   sds_n00                102 }
}

## 3.2 Constructed Parameters
## 3.2.1 CHOICE
35 CHOICE StrParameterBlock {
    { announcementBlock      0 AnnouncementBlock      }
}

CHOICE UserID {
40   { dn                    1 Dn }
}

## 3.2.2 SEQUENCE
SEQUENCE AnnouncementBlock {
45   { uninterAnnounceBlock  1 UninterAnnounceBlock OPT }
}

SEQUENCE ApplicationError {
50   { applicationErrorString 55 ApplicationErrorString }
}
## { extensionParameter      84 ExtensionParameter OPT } deleted
from ApplicationError

55 SEQUENCE ExtensionParameter {
    { assignmentAuthority { 6 UNIVERSAL } AssignmentAuthority }
    { epParameters        { 17 UNIVERSAL } EpParameters }
}

60 SEQUENCE FailureReport {
    { failureCause         32 FailureCause }
}

```


30

```

}
##      { extensionParameter 84 ExtensionParameter OPT } deleted from
FailureReport

5      SEQUENCE ApplicationErrorString {
      { errorCause          56 ErrorCause          }
      }

10     ## 3.2.3 SEQUENCEOF
      SEQUENCEOF GenericAddressList 10 GenericAddress 80

      SEQUENCEOF UninterAnnounceBlock 10 AnnounceElement { 4 UNIVERSAL }

15     ## 3.2.4 SET
      SET EpParameters {
20         { servTranslationScheme 1 ServTranslationScheme OPT }
         { callType          2 CallType OPT }
         { satRestriction    3 NULL OPT }
         { classOfSvc        4 ClassOfSvc OPT }
         { billSequenceNumber 9 BillSequenceNumber OPT }
25         { callBranding     5 CallBranding OPT }
         { universalAccess   10 UniversalAccess OPT }
      }

      ## 3.3 User Defined Parameters
30     USER_DEFINE AccessCode          AINDigits
      USER_DEFINE CalledPartyID        AINDigits
      USER_DEFINE CallingPartyID       AINDigits
      USER_DEFINE ChargeNumber         AINDigits
      USER_DEFINE CollectedAddressInfo AINDigits
35     USER_DEFINE CollectedDigits    AINDigits
      USER_DEFINE OutpulseNumber       AINDigits
      USER_DEFINE AlternateTrunkGroup   TrunkGroupType
      USER_DEFINE PrimaryTrunkGroup     TrunkGroupType
40     USER_DEFINE SecondAlternateTrunkGroup TrunkGroupType

      USER_DEFINE Carrier              CarrierFormat

      ##
45     ## 3.4 Bitfield Parameters
      ##
      BITFIELD AINDigits {
50         { odd_even    BIT_DGT_ODDEVEN    1      }
         { nat_of_num   BIT_ENUM            7      }
         { spare BIT_NULL 1                  }
         { num_plan     BIT_ENUM            3      }
         { pri          BIT_ENUM            2      }
         { si           BIT_ENUM            2      }
         { digits       BIT_DGT            0 24 odd_even }
55     }

      ### AINDigits FIELD DEFINITION START ----
      BIT_ENUM AINDigits nat_of_num {
60         { not_applicable          0 }
         { subscriber_number         1 }
         { reserved_for_national_use 2 }

```

31

```

    {
        national_number          3 }
        international_number      4 }
        partitioned_number       96 }
        acct_number              97 }
5      ani_number                98 }
        i2ani_number             99 }
        authcode_number          100 }
        hotline_number           101 }
10     mccs_number              102 }
        pin_number               103 }
        vpn_number               104 }
        n00_number               105 }
    }

15     BIT_ENUM AINDigits num_plan {
        { unknown_or_not_applicable 0 }
        { isdn_numbering_plan       1 }
        { private_numbering_plan    5 }
    }

20     BIT_ENUM AINDigits pri {
        { presentation_allowed       0 }
        { presentation_restricted    1 }
        { number_unavailable         2 }
    }

25     BIT_ENUM AINDigits si {
        { reserved_for_user_provided 0 }
        { user_provided_passed_network_screening 1 }
30     { reserved_for_user_privated_failed_network_screening 2 }
    }

    ### ---- AINDigits FIELD DEFINITION END

35     ## number of digits is determined by filed num_of_digits
    BITFIELD AnnounceElement {
        { system_announcement_id BIT_INT 16 }
        { number_of_digits       BIT_DGT_NUMDIGITS 8 }
        { digits                 BIT_DGT
40     }
    }

    BIT_INT AnnounceElement system_announcement_id 0 65535 100

45     BITFIELD BillSequenceNumber {
        { scp_num BIT_INT 2 }
        { instance_num BIT_INT 6 }
        { serial_num BIT_INT 24 }
    }

50     BITFIELD CarrierFormat {
        { carrier_selection BIT_ENUM 8 }
        { number_of_digits BIT_DGT_NUMDIGITS 8 }
        { digits BIT_DGT 4 4 number_of_digits }
55     }

    BIT_ENUM CarrierFormat carrier_selection {
        { no_indication 0 }
        { presubscribed_and_no_input 1 }
60     { presubscribed_and_input 2 }
    }

```

32

```

    { presubscribed_and_no_indication_ofinput 3 }
    { not_presubscribed_and_input 4 }
}

5
BITFIELD GenericAddress {
    { type_of_addr BIT_ENUM 8 }
    { odd_even BIT_DGT_ODDEVEN 1 }
    { nat_of_addr_ind BIT_ENUM 7 }
10 { spare BIT_NULL 1 }
    { num_plan BIT_ENUM 3 }
    { pres BIT_ENUM 2 }
    { resv BIT_NULL 2 }
    { addr_signal BIT_DGT 1 16 odd_even }
15 }

### GenericAddress FIELD DEFINITION START ----
#BIT_ENUM GenericAddress type_of_addr {
20 # { dialed_num 0 }
    # { destination_num 1 }
    # { suppl_user_prov_calling_addr_failed_scr 2 }
    # { suppl_user_prov_calling_addr_not_scr 3 }
    # { completion_num 4 }
    # { alternate_outpulse_num 100 }
25 # { second_alternate_outpulse_num 101 }
    # { overflow_routing_num 102 }
    #}

BIT_ENUM GenericAddress type_of_addr {
30 { alternate_outpulse_num 96 }
    { second_alternate_outpulse_num 97 }
    { overflow_routing_num 98 }
}

35 # changed unique_international_num from 5 to 4
    # added vpn 104
BIT_ENUM GenericAddress nat_of_addr_ind {
    { unique_subscriber_num 1 }
    { unique_national_num 3 }
40 { unique_international_num 4 }
    { abbreviated_num 6 }
    { vpn 104 }
    { non_unique_subscriber_num 113 }
    { non_unique_national_num 115 }
45 { non_unique_international_num 116 }
    { test_line_test_code 119 }
}

BIT_ENUM GenericAddress num_plan {
50 { isdn_num_plan 1 }
    { private 5 }
}

BIT_ENUM GenericAddress pres {
55 { presentation_allowed 0 }
    { presentation_restricted 1 }
}

### ---- GenericAddress FIELD DEFINITION END

60 ## TrunkGroupType call_treat_ind is chosen as BIT_NULL because it
    ## is for future use.

```

```

5      BITFIELD TrunkGroupType {
        { no_to_outpulse    BIT_ENUM    1 }
        { sfg_ind           BIT_ENUM    1 }
        { call_treat_ind    BIT_NULL    6 }
10     { digits             BIT_DGT     8 8 }
      }

    ### TrunkGroupType FIELD DEFINITION START ----
    BIT_ENUM TrunkGroupType no_to_outpulse {
15     { outpulse_no        0 }
        { normal_routing_no 1 }
    }

    BIT_ENUM TrunkGroupType sfg_ind {
15     { not_sfg            0 }
        { sfg               1 }
    }

    ### ---- TrunkGroupType FIELD DEFINITION END
20

    ## 3.4 BIT_MAP
    BCD_MAP {
25     { 0      0 }
        { 1      1 }
        { 2      2 }
        { 3      3 }
        { 4      4 }
        { 5      5 }
        { 6      6 }
30     { 7      7 }
        { 8      8 }
        { 9      9 }
        { 13     * }
        { 14     # }
35     { 15     S }
    }

```

The below Table 2 illustrates one example of a "dot" file listing fully-qualified names of leaf-node parameters contained in the transaction capabilities application part message definition file of Table 1.

TABLE 2

```

##### -> TMD for CUSTOMERNAME 1.0 <- #####
##### ::INVOKE
#####
10  ### Operation Name: AnalyzeRoute
    chargeNumber.odd_even
    chargeNumber.nat_of_num
    chargeNumber.spare
    chargeNumber.num_plan
15  chargeNumber.pri
    chargeNumber.si
    chargeNumber.digits
    callingPartyID.odd_even
    callingPartyID.nat_of_num
20  callingPartyID.spare
    callingPartyID.num_plan
    callingPartyID.pri
    callingPartyID.si
    callingPartyID.digits
25  calledPartyID.odd_even
    calledPartyID.nat_of_num
    calledPartyID.spare
    calledPartyID.num_plan
    calledPartyID.pri
30  calledPartyID.si
    calledPartyID.digits
    outputpulseNumber.odd_even
    outputpulseNumber.nat_of_num
    outputpulseNumber.spare
35  outputpulseNumber.num_plan
    outputpulseNumber.pri
    outputpulseNumber.si
    outputpulseNumber.digits
    primaryTrunkGroup.no_to_outputpulse
40  primaryTrunkGroup.sfg_ind
    primaryTrunkGroup.call_treat_ind
    primaryTrunkGroup.digits
    alternateTrunkGroup.no_to_outputpulse
    alternateTrunkGroup.sfg_ind
45  alternateTrunkGroup.call_treat_ind
    alternateTrunkGroup.digits
    secondAlternateTrunkGroup.no_to_outputpulse
    secondAlternateTrunkGroup.sfg_ind
    secondAlternateTrunkGroup.call_treat_ind
50  secondAlternateTrunkGroup.digits
    extensionParameter.assignmentAuthority
    extensionParameter.epParameters.servTranslationScheme
    extensionParameter.epParameters.callType
    extensionParameter.epParameters.satRestriction
55  extensionParameter.epParameters.classOfSvc
    extensionParameter.epParameters.billSequenceNumber.scp_num

```

```
extensionParameter.epParameters.billSequenceNumber.instance_num
extensionParameter.epParameters.billSequenceNumber.serial_num
extensionParameter.epParameters.callBranding
extensionParameter.epParameters.universalAccess
5 genericAddressList(0).GenericAddress.type_of_addr
genericAddressList(0).GenericAddress.odd_even
genericAddressList(0).GenericAddress.nat_of_addr_ind
genericAddressList(0).GenericAddress.spare
genericAddressList(0).GenericAddress.num_plan
10 genericAddressList(0).GenericAddress.pres
genericAddressList(0).GenericAddress.resv
genericAddressList(0).GenericAddress.addr_signal
genericAddressList(1).GenericAddress.type_of_addr
genericAddressList(1).GenericAddress.odd_even
15 genericAddressList(1).GenericAddress.nat_of_addr_ind
genericAddressList(1).GenericAddress.spare
genericAddressList(1).GenericAddress.num_plan
genericAddressList(1).GenericAddress.pres
genericAddressList(1).GenericAddress.resv
20 genericAddressList(1).GenericAddress.addr_signal
genericAddressList(2).GenericAddress.type_of_addr
genericAddressList(2).GenericAddress.odd_even
genericAddressList(2).GenericAddress.nat_of_addr_ind
genericAddressList(2).GenericAddress.spare
25 genericAddressList(2).GenericAddress.num_plan
genericAddressList(2).GenericAddress.pres
genericAddressList(2).GenericAddress.resv
genericAddressList(2).GenericAddress.addr_signal
genericAddressList(3).GenericAddress.type_of_addr
30 genericAddressList(3).GenericAddress.odd_even
genericAddressList(3).GenericAddress.nat_of_addr_ind
genericAddressList(3).GenericAddress.spare
genericAddressList(3).GenericAddress.num_plan
genericAddressList(3).GenericAddress.pres
35 genericAddressList(3).GenericAddress.resv
genericAddressList(3).GenericAddress.addr_signal
genericAddressList(4).GenericAddress.type_of_addr
genericAddressList(4).GenericAddress.odd_even
genericAddressList(4).GenericAddress.nat_of_addr_ind
40 genericAddressList(4).GenericAddress.spare
genericAddressList(4).GenericAddress.num_plan
genericAddressList(4).GenericAddress.pres
genericAddressList(4).GenericAddress.resv
genericAddressList(4).GenericAddress.addr_signal
45 genericAddressList(5).GenericAddress.type_of_addr
genericAddressList(5).GenericAddress.odd_even
genericAddressList(5).GenericAddress.nat_of_addr_ind
genericAddressList(5).GenericAddress.spare
genericAddressList(5).GenericAddress.num_plan
50 genericAddressList(5).GenericAddress.pres
genericAddressList(5).GenericAddress.resv
genericAddressList(5).GenericAddress.addr_signal
genericAddressList(6).GenericAddress.type_of_addr
genericAddressList(6).GenericAddress.odd_even
55 genericAddressList(6).GenericAddress.nat_of_addr_ind
genericAddressList(6).GenericAddress.spare
genericAddressList(6).GenericAddress.num_plan
genericAddressList(6).GenericAddress.pres
genericAddressList(6).GenericAddress.resv
60 genericAddressList(6).GenericAddress.addr_signal
genericAddressList(7).GenericAddress.type_of_addr
```

```
genericAddressList(7).GenericAddress.odd_even
genericAddressList(7).GenericAddress.nat_of_addr_ind
genericAddressList(7).GenericAddress.spare
5 genericAddressList(7).GenericAddress.num_plan
genericAddressList(7).GenericAddress.pres
genericAddressList(7).GenericAddress.resv
genericAddressList(7).GenericAddress.addr_signal
genericAddressList(8).GenericAddress.type_of_addr
10 genericAddressList(8).GenericAddress.odd_even
genericAddressList(8).GenericAddress.nat_of_addr_ind
genericAddressList(8).GenericAddress.spare
genericAddressList(8).GenericAddress.num_plan
genericAddressList(8).GenericAddress.pres
15 genericAddressList(8).GenericAddress.resv
genericAddressList(8).GenericAddress.addr_signal
genericAddressList(9).GenericAddress.type_of_addr
genericAddressList(9).GenericAddress.odd_even
genericAddressList(9).GenericAddress.nat_of_addr_ind
20 genericAddressList(9).GenericAddress.spare
genericAddressList(9).GenericAddress.num_plan
genericAddressList(9).GenericAddress.pres
genericAddressList(9).GenericAddress.resv
genericAddressList(9).GenericAddress.addr_signal

25
### Operation Name: Close
userID.dn
bearerCapability
closeCause
30

### Operation Name: Continue
extensionParameter.assignmentAuthority
extensionParameter.epParameters.servTranslationScheme
35 extensionParameter.epParameters.callType
extensionParameter.epParameters.satRestriction
extensionParameter.epParameters.classOfSvc
extensionParameter.epParameters.billSequenceNumber.scp_num
extensionParameter.epParameters.billSequenceNumber.instance_num
40 extensionParameter.epParameters.billSequenceNumber.serial_num
extensionParameter.epParameters.callBranding
extensionParameter.epParameters.universalAccess

45
### Operation Name: Disconnect
extensionParameter.assignmentAuthority
extensionParameter.epParameters.servTranslationScheme
extensionParameter.epParameters.callType
extensionParameter.epParameters.satRestriction
50 extensionParameter.epParameters.classOfSvc
extensionParameter.epParameters.billSequenceNumber.scp_num
extensionParameter.epParameters.billSequenceNumber.instance_num
extensionParameter.epParameters.billSequenceNumber.serial_num
extensionParameter.epParameters.callBranding
55 extensionParameter.epParameters.universalAccess

### Operation Name: InfoAnalyzed
60 userID.dn
bearerCapability
calledPartyID.odd_even
```

```
calledPartyID.nat_of_num
calledPartyID.spare
calledPartyID.num_plan
calledPartyID.pri
5 calledPartyID.si
calledPartyID.digits
triggerCriteriaType
chargeNumber.odd_even
chargeNumber.nat_of_num
10 chargeNumber.spare
chargeNumber.num_plan
chargeNumber.pri
chargeNumber.si
chargeNumber.digits
15 callingPartyID.odd_even
callingPartyID.nat_of_num
callingPartyID.spare
callingPartyID.num_plan
callingPartyID.pri
20 callingPartyID.si
callingPartyID.digits
carrier.carrier_selection
carrier.number_of_digits
carrier.digits
25 accessCode.odd_even
accessCode.nat_of_num
accessCode.spare
accessCode.num_plan
accessCode.pri
30 accessCode.si
accessCode.digits
collectedAddressInfo.odd_even
collectedAddressInfo.nat_of_num
collectedAddressInfo.spare
35 collectedAddressInfo.num_plan
collectedAddressInfo.pri
collectedAddressInfo.si
collectedAddressInfo.digits
collectedDigits.odd_even
40 collectedDigits.nat_of_num
collectedDigits.spare
collectedDigits.num_plan
collectedDigits.pri
collectedDigits.si
45 collectedDigits.digits
extensionParameter.assignmentAuthority
extensionParameter.epParameters.servTranslationScheme
extensionParameter.epParameters.callType
extensionParameter.epParameters.satRestriction
50 extensionParameter.epParameters.classOfSvc
extensionParameter.epParameters.billSequenceNumber.scp_num
extensionParameter.epParameters.billSequenceNumber.instance_num
extensionParameter.epParameters.billSequenceNumber.serial_num
extensionParameter.epParameters.callBranding
55 extensionParameter.epParameters.universalAccess

### Operation Name: ReportError
applicationErrorString.errorCause
60
```



```
### Operation Name: SendToResource
resourceType
strParameterBlock.announcementBlock.uninterAnnounceBlock(0).AnnounceEle
ment.system_announcement_id
5 strParameterBlock.announcementBlock.uninterAnnounceBlock(0).AnnounceEle
ment.number_of_digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(0).AnnounceEle
ment.digits
10 strParameterBlock.announcementBlock.uninterAnnounceBlock(1).AnnounceEle
ment.system_announcement_id
strParameterBlock.announcementBlock.uninterAnnounceBlock(1).AnnounceEle
ment.number_of_digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(1).AnnounceEle
ment.digits
15 strParameterBlock.announcementBlock.uninterAnnounceBlock(2).AnnounceEle
ment.system_announcement_id
strParameterBlock.announcementBlock.uninterAnnounceBlock(2).AnnounceEle
ment.number_of_digits
20 strParameterBlock.announcementBlock.uninterAnnounceBlock(2).AnnounceEle
ment.digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(3).AnnounceEle
ment.system_announcement_id
strParameterBlock.announcementBlock.uninterAnnounceBlock(3).AnnounceEle
ment.number_of_digits
25 strParameterBlock.announcementBlock.uninterAnnounceBlock(3).AnnounceEle
ment.digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(4).AnnounceEle
ment.system_announcement_id
strParameterBlock.announcementBlock.uninterAnnounceBlock(4).AnnounceEle
ment.number_of_digits
30 strParameterBlock.announcementBlock.uninterAnnounceBlock(4).AnnounceEle
ment.digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(5).AnnounceEle
ment.system_announcement_id
35 strParameterBlock.announcementBlock.uninterAnnounceBlock(5).AnnounceEle
ment.number_of_digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(5).AnnounceEle
ment.digits
40 strParameterBlock.announcementBlock.uninterAnnounceBlock(6).AnnounceEle
ment.system_announcement_id
strParameterBlock.announcementBlock.uninterAnnounceBlock(6).AnnounceEle
ment.number_of_digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(6).AnnounceEle
ment.digits
45 strParameterBlock.announcementBlock.uninterAnnounceBlock(7).AnnounceEle
ment.system_announcement_id
strParameterBlock.announcementBlock.uninterAnnounceBlock(7).AnnounceEle
ment.number_of_digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(7).AnnounceEle
ment.digits
50 strParameterBlock.announcementBlock.uninterAnnounceBlock(8).AnnounceEle
ment.system_announcement_id
strParameterBlock.announcementBlock.uninterAnnounceBlock(8).AnnounceEle
ment.number_of_digits
55 strParameterBlock.announcementBlock.uninterAnnounceBlock(8).AnnounceEle
ment.digits
strParameterBlock.announcementBlock.uninterAnnounceBlock(9).AnnounceEle
ment.system_announcement_id
60 strParameterBlock.announcementBlock.uninterAnnounceBlock(9).AnnounceEle
ment.number_of_digits
```

```
strParameterBlock.announcementBlock.uninterAnnounceBlock(9).AnnounceEle  
ment.digits  
disconnectFlag  
answerIndicator
```

5

```
#### ::RR
```

```
####
```

```
#### ::RE
```

10

```
####
```

```
Operation Name: ApplicationError  
applicationErrorString.errorCause
```

15

```
Operation Name: FailureReport  
failureCause
```

20

Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions, and alterations may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A method of implementing a transaction capabilities application part application protocol for transaction capabilities application part communication,
5 the method comprising the steps of:

providing a transaction capabilities application part message definition;

generating a plurality of service independent building blocks to form a service logic program associated with transaction capabilities application part communication, at
10 least one of the plurality of service independent building blocks associating a plurality of leaf-node parameters with respective variables in the at least one service independent building block, the leaf-node parameters
15 specified by fully qualified names derived from the transaction capabilities application part message definition; and

creating an executable form of the service independent building blocks for execution.

20

2. The method of Claim 1 wherein the at least one service independent building block comprises a service independent building block operable to get a value of a leaf-node parameter associated with the transaction
25 capabilities application part message definition.

3. The method of Claim 1 wherein the at least one service independent building block comprises a service independent building block operable to set a value of a leaf-node parameter associated with the transaction
30 capabilities application part message definition.

4. The method of Claim 1 wherein the at least one service independent building block comprises a service independent building block operable to send and receive transaction capabilities application part messages.

5

5. The method of Claim 1 wherein the step of creating an executable form of the service independent building blocks for execution comprises the steps of:

10 selecting from an object library object classes corresponding to the plurality of service independent building blocks in the service logic program;

initiating objects of the select object classes; and

creating an executable logic program having instances of the object classes.

15

6. The method of Claim 1 wherein the step of defining a transaction capabilities application part application protocol comprises forming a transaction capabilities application part message definition file.

20

7. The method of Claim 1 wherein the step of defining a plurality of service independent building blocks to form a logic program comprises creating by a utility at least one service independent building block template file
25 for facilitating definition of the plurality of service independent building blocks.

8. A method for coding transaction capabilities application part services according to a transaction capabilities application part application protocol, the method comprising the steps of:

5 defining a transaction capabilities application part application protocol having at least one user-defined message and user-defined parameter;

 generating a set of fully-qualified names specifying leaf-node parameters associated with the at least one user-defined message;

10

 defining a plurality of service independent building blocks to form a logic program for communicating transaction capabilities application part messages, the at least one service independent building block associating the leaf-node parameters with variables internal to the at least one service independent building block;

15

 selecting from an object library object classes corresponding to the service independent building blocks in the logic program;

20 initiating objects of the select object classes; and
 creating an executable logic program having instances of the object classes.

9. The method of Claim 8 wherein the step of
25 defining a transaction capabilities application part application protocol comprises forming a transaction capabilities application part message definition file.

10. The method of Claim 9 wherein the transaction
30 capabilities application part message definition file is formed using Tcl scripting language.

11. The method of Claim 8 wherein the step of defining a plurality of service independent building blocks comprises defining a service independent building block adapted to assign values to parameters specified by a fully qualified name.

12. The method of Claim 8 wherein the step of defining a plurality of service independent building blocks comprises defining a service independent building block adapted to retrieve values of parameters specified by a fully qualified name.

13. The method of Claim 8 wherein the step of defining a plurality of service independent building blocks comprises defining a service independent building block adapted to set values of parameters specified by a fully qualified name.

14. The method of Claim 8 wherein the step of defining a plurality of service independent building blocks to form a logic program performing a transaction capabilities application part service associated with the user defined parameters comprises creating by a utility a plurality of service independent building block template files for facilitating definition of the plurality of service independent building blocks.

15. A system for implementing a transaction capabilities application part application protocol for transaction capabilities application part communication, the system comprising:

5 a transaction capabilities application part message set definition having a plurality of messages and parameters specifying the transaction capabilities application part application protocol;

10 a plurality of service independent building blocks having internal variables, the plurality of service independent blocks associating the internal variables with fully qualified names specifying leaf-node parameters derived from the transaction capabilities application part message definition set;

15 a graphical editor adapted for facilitating a user to select and link the plurality of service independent building blocks to form a logic program associated with a transaction capabilities application part messages;

20 an object library having a plurality of pre-defined object classes each corresponding to a service independent building block; and

25 a logic interpreter adapted for receiving the logic program and creating instances of objects from the pre-defined object classes in the object library to correspond with the plurality of service independent building blocks in the logic program to produce an executable logic program operable to receive transaction capabilities application part information identified by fully qualified names specifying leaf-node parameters and transmit transaction capabilities application part information associated with
30 fully qualified names specifying leaf-node parameters.

16. The system of Claim 15 wherein the logic interpreter comprises a parser for parsing the logic program.

5 17. The system of Claim 15 wherein the logic interpreter comprises an execution function adapted for receiving a transactions capabilities application part message and selecting an appropriate executable logic program for executing the request.

10

18. The system of Claim 15 wherein the graphical editor comprises user-manipulatable icon representations of the service independent building blocks.

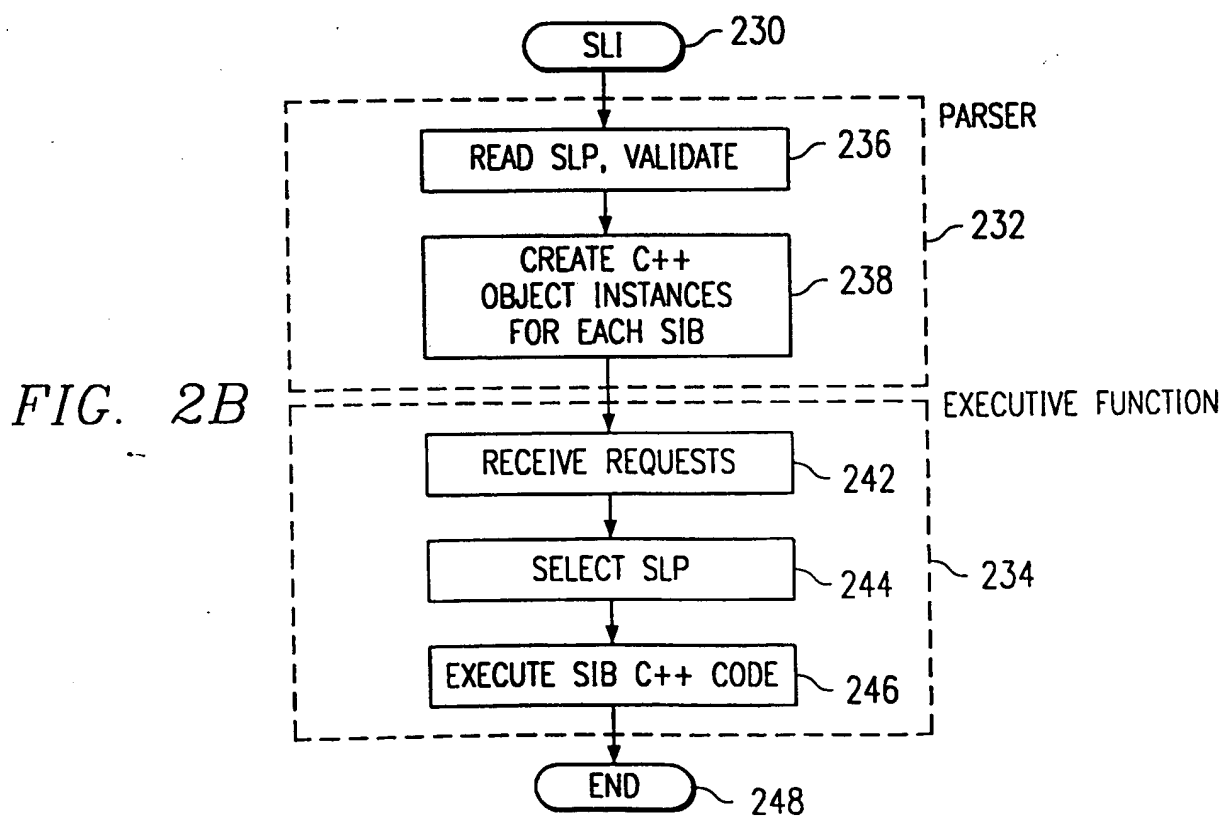
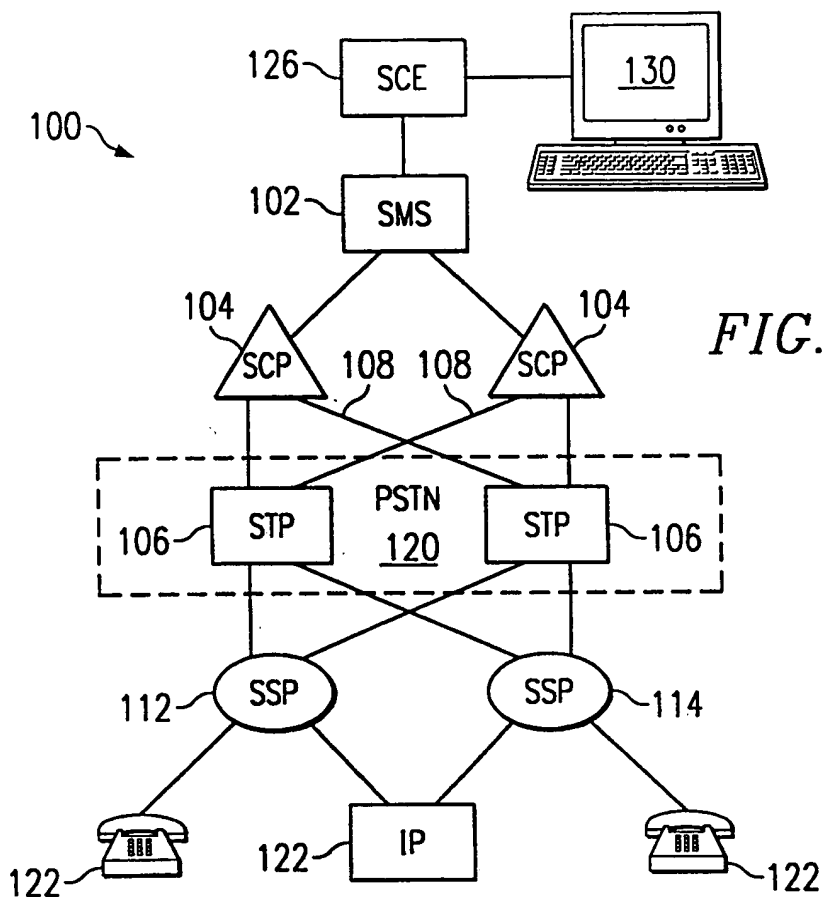
15 19. The system of Claim 15 wherein the service independent building block comprises a service independent building block for assigning values to parameters represented by a fully qualified name.

20 20. The system of Claim 15 wherein the service independent building block comprises a service independent building block for retrieving values of a parameter specified by a fully qualified name.

25 21. The system of Claim 15 and further comprising a utility for receiving the transaction capabilities application part message set definition and creating a service independent building block template file associating a plurality of fully qualified names specifying
30 leaf-node parameters with internal variables of the service independent building blocks for facilitating generation of the plurality of service independent building blocks.

22. The system of Claim 15 wherein the plurality of pre-defined service independent building blocks comprises a Get block, a Set block, an Entry block, and a SendReceive block.

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FIG. 2A

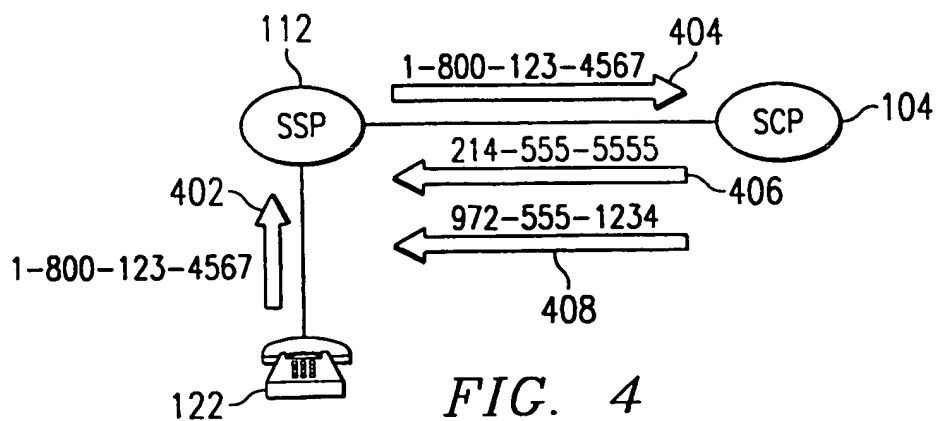
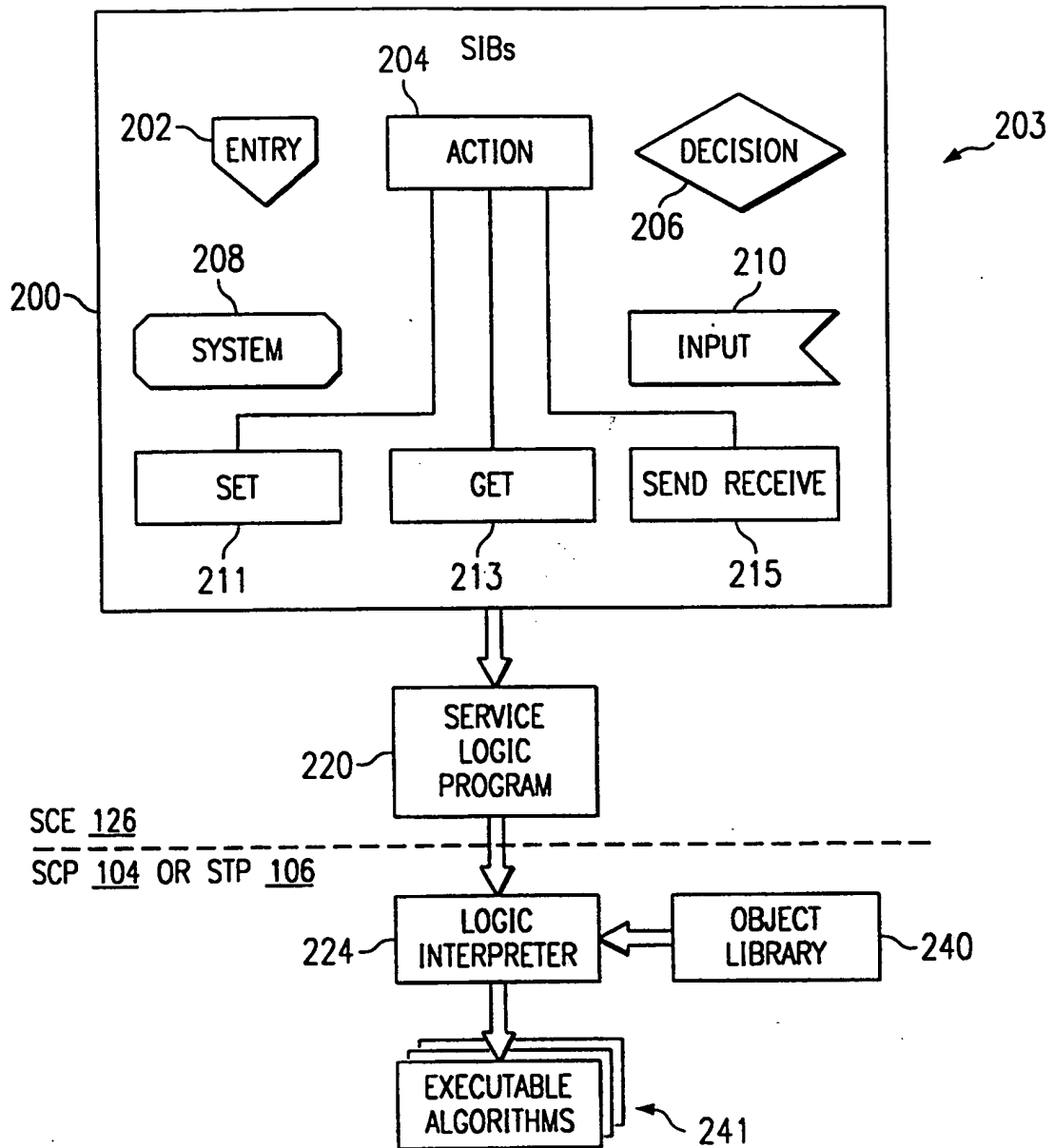
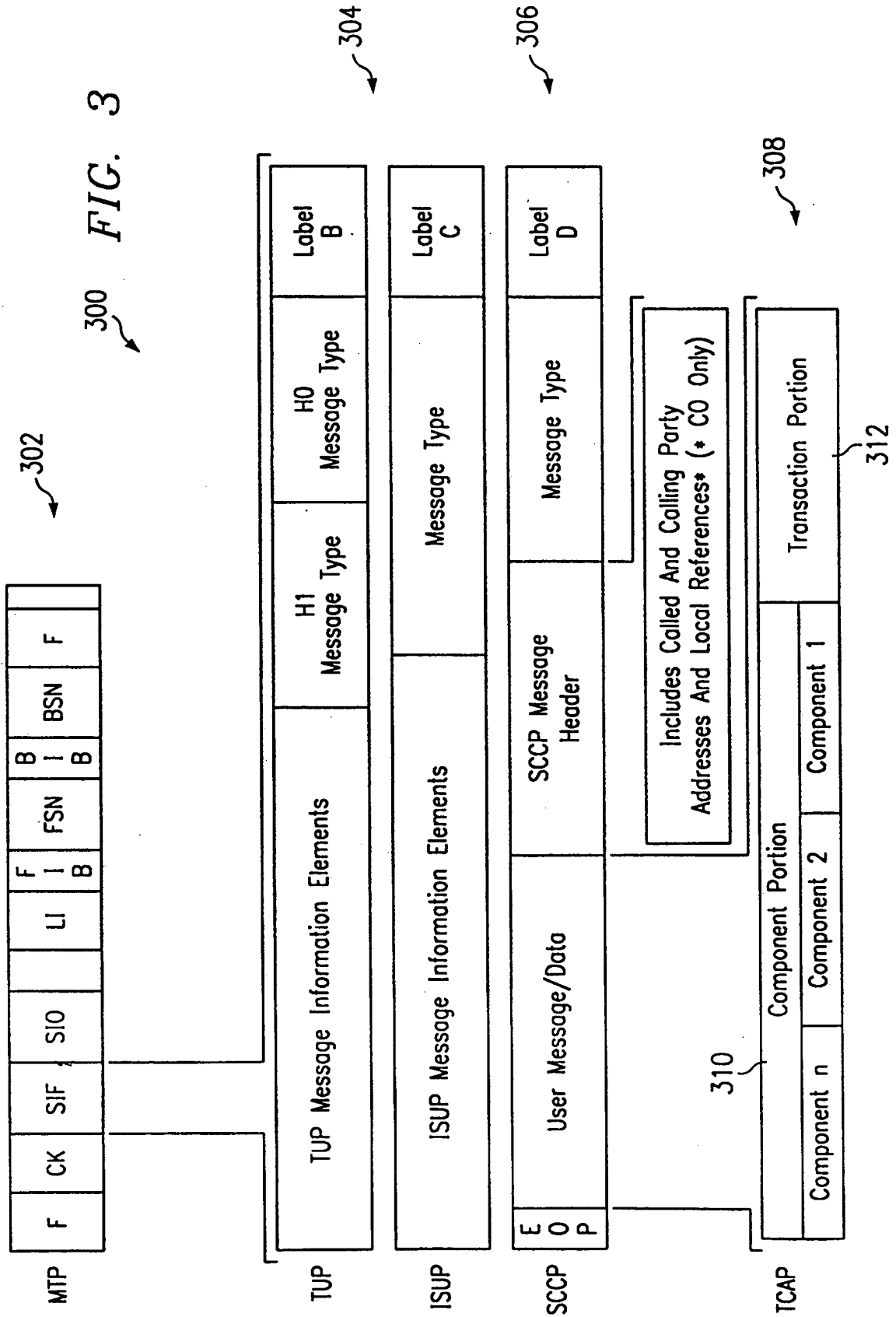


FIG. 4



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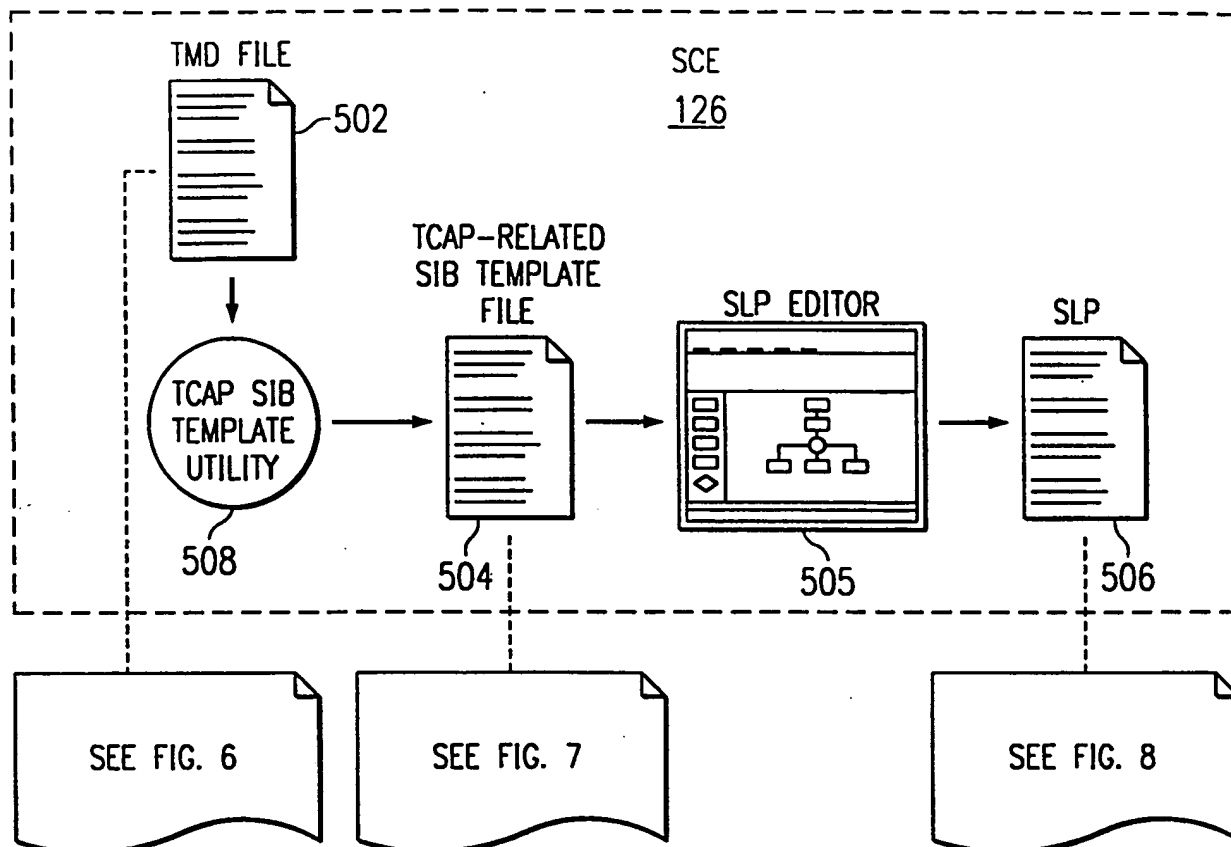


FIG. 5

```

SEQUENCE InfoAnalyzed {
    ...
    { calledPartyID 15 CalledPartyID OPT }
    ...
}
...
USER_DEFINE CalledPartyID      AINDigits
BITFIELD AINDigits {
    { odd_even BIT_DGT_ODDEVEN 1 }
    { not_of_num BIT_ENUM 7 }
    { spare BIT_NULL 1 }
    { num_plan BIT_ENUM 3 }
    { pri BIT_ENUM 2 }
    { si BIT_ENUM 2 }
    { digits BIT_DGT 1 64 odd_even }
}
  
```

FIG. 6

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FIG. 7

```

EXTDEF_PARAM: Var: integer_type_id calledPartyID.odd_even CalledPID.odd_even alloc_call Edt: 001
EXTDEF_PARAM: Var: integer_type_id calledPartyID.nat_of_num CalledPID.nat_of_num alloc_call Edt: 001
EXTDEF_PARAM: Var: integer_type_id calledPartyID.spare CalledPID.spare alloc_call Edt: 001
EXTDEF_PARAM: Var: integer_type_id calledPartyID.num_plan CalledPID.num_plan alloc_call Edt: 001
EXTDEF_PARAM: Var: integer_type_id calledPartyID.pri CalledPID.pri alloc_call Edt: 001
EXTDEF_PARAM: Var: integer_type_id calledPartyID.si CalledPID.si alloc_call Edt:001
EXTDEF_PARAM: Var: phone_nr_type_id calledPartyID.digits CalledPID.digits alloc_call Edt:001

```

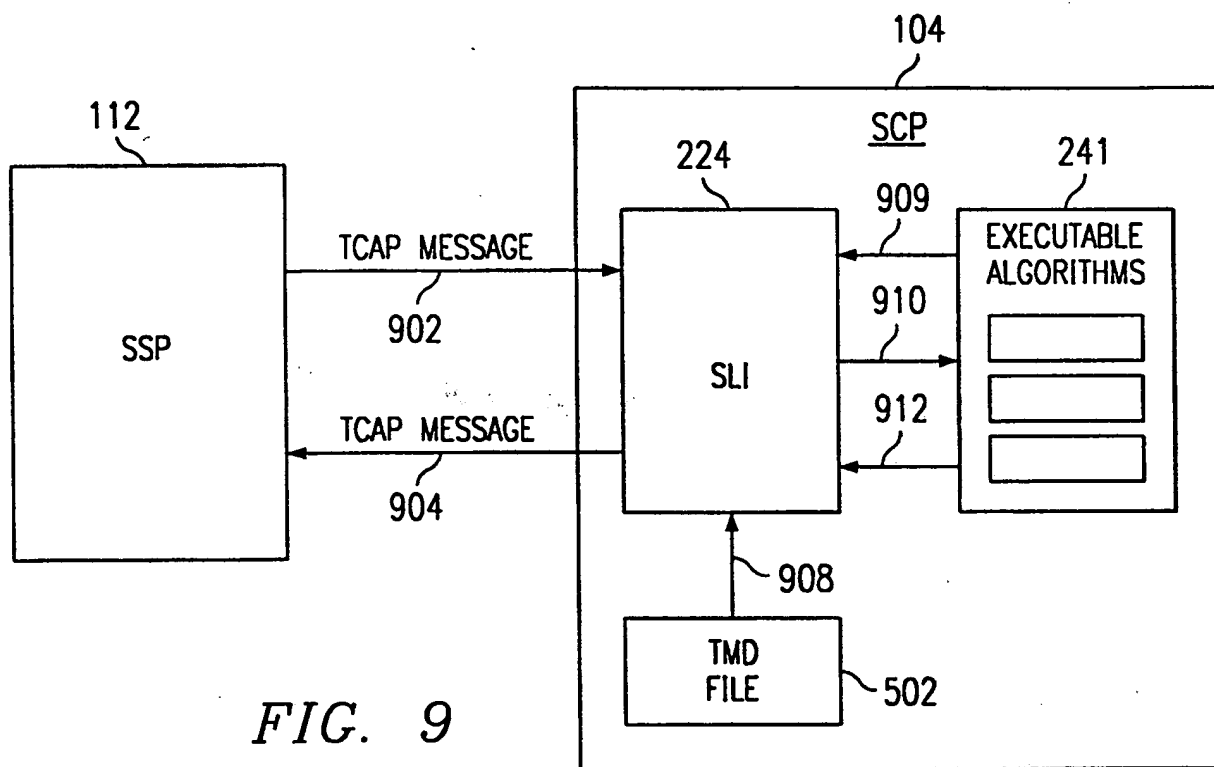
FIG. 8

```

SIB Code: ACTION 4
SIB_Type: SIB_action_get action_get
SIB_Expr: Var: integer_type_id "" "calledPartyID.nat_of_num"
"CalledPID.nat_of_num" "alloc_call" "" "" Edt: 17 Vql: 0 Desc: CALLEDPARTYID
SIB_Expr: Var: integer_type_id "" "calledPartyID.num_plan" "CalledPID.num_plan"
"alloc_call" "" "" Edt: 17 Vql: 0 Desc: CALLEDPARTYID
SIB_Expr: Var: integer_type_id "" "calledPartyID.pri" "CalledPID.pri" "alloc_call"
"" "" Edt: 17 Vql: 0 Desc: CALLEDPARTYID
SIB_Expr: Var: integer_type_id "" "calledPartyID.si" "CalledPID.si" "alloc_call"
"" "" Edt: 17 Vql: 0 Desc: CALLEDPARTYID
SIB_Expr: Var: phone_nr_type_id "" "calledPartyID.digits" "CalledPID.digits"
"alloc_call" "" "" Edt: 17 Vql: 0 Desc: CALLEDPARTYID
SIB_Expr: IntoAnalyzed

```

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04Q 3/00	A3	(11) International Publication Number: WO 99/09723 (43) International Publication Date: 25 February 1999 (25.02.99)
(21) International Application Number: PCT/US98/17358 (22) International Filing Date: 21 August 1998 (21.08.98) (30) Priority Data: 08/918,693 21 August 1997 (21.08.97) US (71) Applicant: DSC TELECOM L.P. [US/US]; 1000 Coit Road, Plano, TX 75075 (US). (72) Inventors: LIN, Ching-Der; 4464 Bailey Court, Plano, TX 75093 (US). WHITED, John, L.; 1104 Sundial Drive, Richardson, TX 75093 (US). KANNAN, Comandur, S.; 1808 Polstar Drive, Plano, TX 75093 (US). (74) Agent: FISH, Charles, S.; Baker & Botts, L.L.P., 2001 Ross Avenue, Dallas, TX 75201-2980 (US).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> (88) Date of publication of the international search report: 17 June 1999 (17.06.99)
(54) Title: SYSTEM AND METHOD FOR IMPLEMENTING PROGRAMMABLE TRANSACTION CAPABILITIES APPLICATION PART COMMUNICATION PROTOCOL		
<pre> graph LR 112[SSP] -- 902 TCAP MESSAGE --> 224[SLI] 224 -- 904 TCAP MESSAGE --> 112 502[TMD FILE] -- 908 --> 224 224 -- 909 --> 241[EXECUTABLE ALGORITHMS] 241 -- 910 --> 224 241 -- 912 --> 224 subgraph 104 224 241 502 end </pre>		
(57) Abstract <p>A method of implementing a transaction capabilities application part application protocol for transaction capabilities application part communication includes providing a transaction capabilities application part message definition. The method also includes generating a plurality of service independent building blocks to form a service logic program associated with transaction capabilities application part communication. At least one of the plurality of service independent building blocks associates a plurality of leaf-node parameters with respective variables in the at least one service independent building block. The leaf-node parameters are specified by fully qualified names derived from the transaction capabilities application part message definition. The method also includes creating an executable form of the service independent building blocks for execution.</p>		

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/17358

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04Q3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04Q

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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 34175 A (BORG KENNETH ALLAN ;CORMIER LIDIA DORA (CA); ELLENS CHRISTIAN CORN) 14 December 1995	1
Y	see page 1, line 31 - page 2, line 20 see page 4, line 26 - page 11, line 29 see figures 2,3,5	5,7,15, 17,18
Y	--- GENETTE M ET AL: "INTELLIGENT NETWORK: THE SERVICE CREATION ENVIRONMENT" COMMUTATION ET TRANSMISSION, vol. 17, no. 2, 1 January 1995, pages 13-20, XP000505610 see the whole document --- -/--	5,7,15, 17,18

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 5 574 782 A (BAIRD MICHAEL H ET AL) 12 November 1996 see column 3, line 61 - column 4, line 22 see column 5, line 38 - column 9, line 30 ---	1,5,7, 15,18
Y	KU B S: "A REUSE-DRIVEN APPROACH FOR RAPID TELEPHONE SERVICE CREATION" INTERNATIONAL CONFERENCE ON SOFTWARE REUSE, 1 November 1994, pages 64-72, XP002037010 see the whole document ---	1,5,7, 15,18
P,X	US 5 768 361 A (COWGILL GEORGE A) 16 June 1998 see the whole document ---	1
A	FERIT YEGENOGLU ET AL: "TRANSACTION CAPABILITIES APPLICATION PART AND INTELLIGENT NETWORK SERVICES" DISCOVERING A NEW WORLD OF COMMUNICATIONS, CHICAGO, JUNE 14 - 18, 1992, vol. 2, 14 June 1992, pages 582-586, XP000326748 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS see the whole document -----	1-22

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US 5574782	A	12-11-1996	CA	2170668 A	15-10-1996
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